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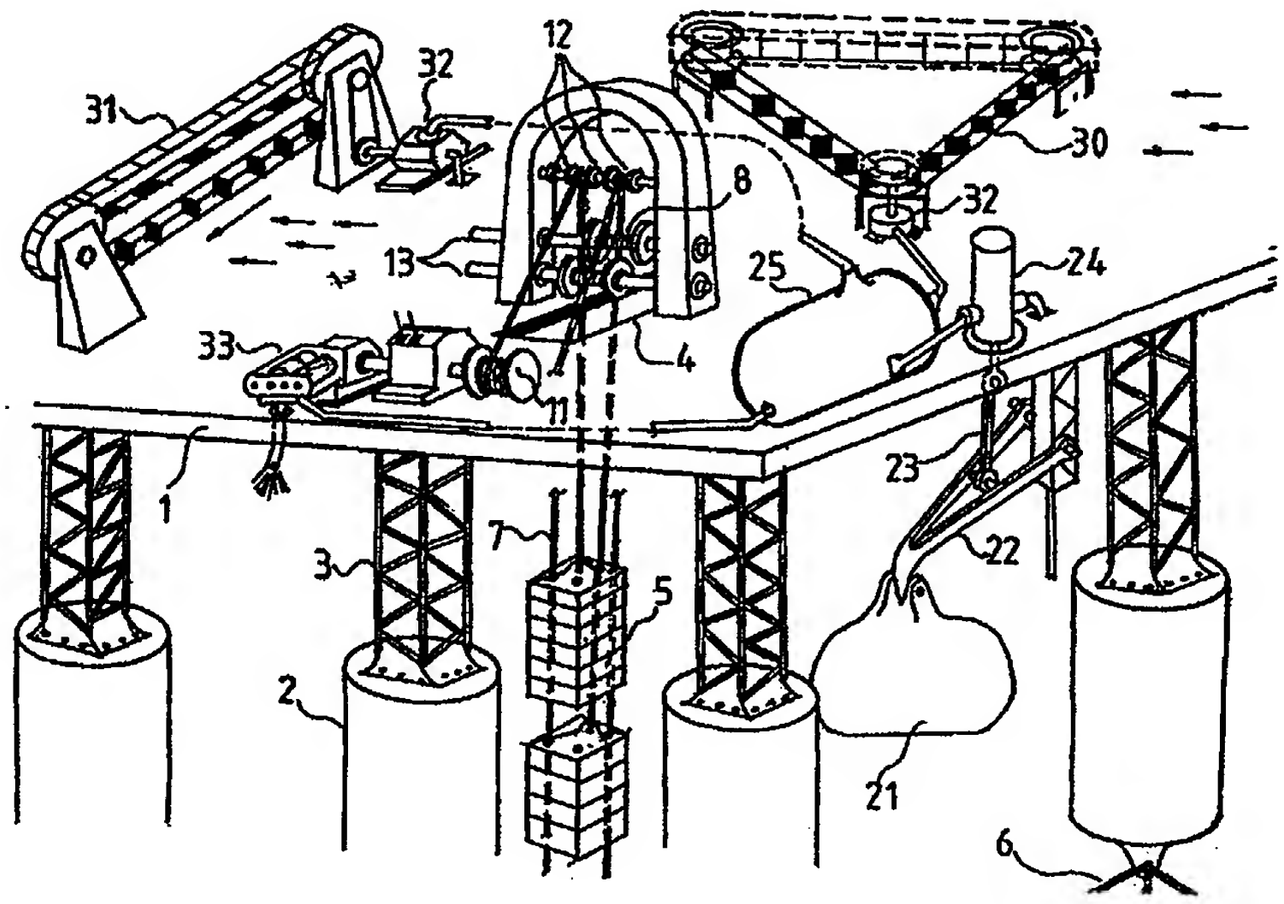
(54) Title: ACCUMULATED WIND AND WAVE POWER PLANT



(57) Abstract

Disclosed are the components and processes to produce and install a functional accumulated power plant to convert and store marine wind and wave energy mechanically offshore, transmission of the energy by high pressure fluid means through a novel hydraulic, steam and pneumatic engine to a similar storage facility on land for end uses.

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TITLE OF INVENTION: ACCUMULATED WIND AND WAVE POWER PLANT

SUMMARY OF INVENTION: The present invention relates to novel power accumulator plant and in particular to the generation of energy from marine wind and wave sources. The plant consist of ocean depth energy storage device, enveloped wave energy converter, wind turbine device hereinafter referred to as sloop loop runner and a pneumo-hydro-vapour engine (PHV).

Accordingly, it is the principal object of the invention to produce and install a functional electric power plant from marine wind and waves and transmit the energy generated by means of high pressure fluid for end uses. This is made possible by means of ocean and land depth storage devices.

Another object is the generation of power from the wind (sloop-loop runner and its variant) and waves (enveloped wave converter) to work high pressure pumps.

Yet another object is the means of transmission of energy to shore or land through high pressure fluid.

A further object is the PHV. engine, which is a hydraulic motor and operates on high pressure fluids.

These, together with other objects and advantages which will become subsequently apparent, reside in the details of construction and operation as more fully hereinafter described and claimed. Drawings, which form part of the description are referred to in numerical form throughout.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of the plant of the present invention showing the components thereof and the various parts as arranged during operation.

Fig. 2 is a lateral view of the sloop loop runner showing its components and arrangements.

Fig. 3 shows the variant of the sloop loop runner.

Fig. 4 shows the inner parts of the pneumo-hydro-vapour engine

DETAILED DESCRIPTION: The use of suspended weights as energy source in the well known "grand father clock" have been well documented. The application of this technology in working an accumulator system to store substantial amount of energy which could be operated as a mechanical battery with little inherent losses form the main thrust of the present invention.

Referring to Figure 1, the floating platform [1] comprising huge metal tanks [2] and structural steel supports [3] with slots [4] provided on the platform is positioned over very deep ocean waters with depths of hundreds or thousands of metres. Several tons of weights [5] made of high density materials such as tungsten, lead, cobalt, nickel, manganese, tin, tinstone, cobaltite, smaltite and iron are loaded on the platform [1] to serve as ballast and to submerge the tanks [2] deep under the waves in such a way as to leave platform proper high above the waves. Hawsers [6] provide stability against drift. The said weights [5] are lowered through slots [4] with cables [7] into the sea below platform [1] and suspended just under the waves to avoid being tossed. The end of cable [7] is wound three or four times around free wheeling clutch [8] mounted on output shaft [13], then over roller [12] to the spool of winch [11].

The wind turbine hereinafter referred to as the sloop-loop runner wind machine(Fig. 2), consists of three multiple pulleys [1] arranged in a triangular configuration on a raised platform with their axes vertical. The three pulleys are connected by means of four belts with several sails secured between the belts. Each pulley has four grooves and is designed in such a way that while the two outer pulleys are larger in diameter and equal in height, the two inner pulleys are also equal in height but smaller in diameter. This design of the pulleys guarantees large rectangular openings between the inner sides of the larger pulleys through which the sails run. The sails consist basically of rectangular frames with suitable materials stretched between the frames. The sails which are secured

between the four belts at intervals extends round the circumference of the belts. A long baffle [3] is provided to isolate two pulleys leaving one pulley exposed to the wind. The device is set into motion as the wind meets the sails obliquely.

A variant of the sloop loop runner as shown in Figure 3 which works on the same principles as the sloop loop runner is incorporated to perform similar functions. It consist of a pair of multiple pulleys, a leading pulley [1a] and a trailing pulley [1b] mounted on tall stands with their axes horizontal. The belts are set around the pulleys with the sails hinged on the inner belts in such a way that they hang down on the bottom half of the whole set-up with their ends resting against cross members [3] between the outer belts. As the winds meet the sails obliquely, the free ends of the sails are pushed against the cross members setting the pulleys in motion. As the sails move around the leading pulley [1a], they collapse and lie on the inner belts of the upper part of the device towards the trailing pulley where they tumble back into position to avoid counter motion of the sails. The output is then taken out from any one of the pulleys.

In reference to Figure 1, the said enveloped wave energy converter comprising a large tank float [21] made of light material such as fibre glass has attached a wishbone arm [22] pivoted on a fixed structure under the platform [1]. Attached freely to the wishbone arm [22] is a rod [23] which operates a piston pump [24] when tank float [21] is worked up and down by the waves. The tank float is filled with as much sea water as it displaces. As the waves meet the float, it is heaved up to work pump [24] on rebound by its weight.

Fig. 4 is a diagram of a novel engine hereinafter referred to as pneumo-hydro-vapour (PHV) engine. The PHV engine is worked by high pressure fluids such as compressed air, pressurized oil or water and steam. The high pressure fluid flows past inlet valve [1] into pressure chamber [2] over piston [3] fitted with seal rings [4] and sliding in cylinder [5]. The pressure on piston [3] forces it down to compress calibrated spring [6]. Piston rod [7] is in constant mesh with output shaft [9], through a rack and pinion arrangement [8] and equipped with a clutch mechanism all mounted on output shaft. Lever [11], pivoted on the block, inserted into longitudinal slot [10] and finally linked to both the

inlet and exhaust valve[1] and [12] by means of push-pull rods [13] through rockers[14] and [16]. Positioned in the inflow line and just before inlet valve [1] is cut-off valve [15]. Each cut-off valve of a particular cylinder is controlled by the push-pull rod of the other cylinder. Two spring loaded restrainer hooks [22] in the form of levers pivoted on the block and located close and between piston rods [7] are employed to eliminate the tendency for the sluggish performance of the PHV-engine especially when oil or water is used as the medium of high pressure feed. When piston rod [7] of one cylinder slides down, hook [22] slides longitudinally against the rod and finally slips into the deep notch [20] and is restrained to complete the bottom stroke. In operation, high pressure fluid flows into pressure chamber [2] with cut-off valve [15] and inlet valve [1] opened and exhaust valve [12] closed. The pressure on the piston forces it down to compress calibrated spring [6]. At the end of the bottom stroke of this cylinder, spring loaded hook [22] slips into notch [20] restraining piston [3] momentarily, and at the same time, the push-pull rod which are inter-connected opens the cut-off valve of the other cylinder to commence the charging process. At this moment, the exhaust process of the other cylinder begins with exhaust valve [12] opened. With the piston at the bottom and hole [30] which is provided with a pressure valve to open when the pressure in the cylinder falls, uncovered and exposed to the atmosphere, the fluid in the pressure chamber is discharged by virtue of atmospheric pressure with the engine operating in a horizontal position. At the end of the charging process of one cylinder, by which time the exhaust process of the other cylinder would have been completed, the pin [21] located on the piston rod of the charging cylinder pushes the hook restraining the discharged cylinder out of the notch to release the piston and compressed spring. Energy stored in compressed spring [6] eventually drives output shaft [9] as the piston is in constant mesh with the output shaft through a rack and pinion arrangement and assisted by a clutch mechanism is released. This cycle is then repeated to ensure the continuous transmission of power.

OPERATION: In operating the plant as illustrated in Figure 1, weights [5] are suspended through slots [4] at depth thirty metres to avoid tossing of the platform at sea by waves. Several enveloped wave converters are spread out on the waves under the platform [1] with pumps the output of which are connected through pipes to pneumatic tank [25], said pneumatic tank serving as an equalizer for all the power outputs from the sloop loop, the variant and the enveloped wave converters. The output of the pneumatic tank is connected through pipes to the PHV. engine to drive winch [11] which raises weights [5] to store potential energy such that when the raised weights are disengaged by winch [11], the stored potential energy converts to kinetic energy which is transmitted through cable [7] to output shaft [13]. The energy from the output shaft [13] is used to work pumps which pump high pressure sea water to shore via pipelines to feed PHV engines on land whose output power may be attached to generators directly to produce electricity or used to work land based storage system which makes use of suspended weights over deep trenches dug in the ground using same principles as the suspended weights system at sea. All water pumps used on the platform at sea should be suitable for the purpose which is to pump water at very high pressure at low speeds. High pressure operation enables the transmission of high power with less medium and smaller pipes and engines, especially the pipeline to shore which may attain considerable lengths. The use of seawater as a medium of power transfer does not involve the storage of any large amounts of water. The reservoirs [25] purpose is to equalize energies from the various sources and allow water to the compressed. Air may replace water using compressors suitable for the purpose to replace water pumps. When air is used to operate the PHV engine, the exhaust air, if allowed to expand in large radiators, may be used in compartments as cold storage facilities.

The installation at sea does not have to be a very large one by virtue of the storage capacity of the land based storage which may be made very large to store hundreds if not thousands of megawatts. Moreover the use of high pressure water or air to feed PHV engines makes it possible to distribute the depth storage facilities far apart, connected by pipeline.

CLAIMS

1. Assembly and operation of accumulated wind and wave power plant useful for the generation of electricity as well as power usage systems, which comprises floating platform means supported fixedly by cylindrical metal tanks, for holding the platform in stable position at sea, said platform means made of structured steel, power generating assembly mounted on the platform, comprising sloop-loop runner, a variant of the sloop-loop runner, enveloped wave device and pneumo-hydro-vapour engine, said, assembly designed in such a way that, said sloop loop runner machine pumps high pressure fluid to pneumo tank, while the said variant and enveloped wave machine performs similar functions in concert or individually to said pneumatic tank, said pneumatic tank delivering high pressure fluids to the PHV engine, said PHV engine converting hydraulic force of said pneumatic means to rotational movement for raising weights, through winches such that the release of weights causes similar rotational movement in output shaft whereby the output shaft drives a terminal pump to permit high pressure fluid to be pumped to shore to work a land based PHV engine connected to winches to perform similar function on land as at sea.

2. The accumulated wind and wave power plant of claim 1 wherein said, sloop-loop runner device consists of three multiple pulleys arranged in a triangular configuration with vertical axes on a platform and connected by means of four belts with several sails secured between the four belts at intervals in such a way that it extends round the circumference of the belts, the said sloop-loop runner positioned in such a way that the wind meets the sails obliquely to set them in motion for high energy output.

3. The accumulated wind and wave power plant of claims 1 and 2, wherein said variant of the sloop loop runner comprises a pair of multiple pulleys on tall stands with horizontal axes, two multiple pulleys coupled with a set of four belts and positioned with their axes horizontal on spindles fixed on tall stands, said variant having sails arranged at equal intervals in such a way that the sails are secured only on the inner pulleys with their ends resting against cross members, said cross members arranged at equal intervals on the outer belts, said variant positioned in such a way that the wind meet the sails obliquely.

4. The accumulated wind and wave power plant of claim 1, wherein the said enveloped wave converter comprises large tank float, with a wishbone and rod attached to the said float tank, providing means of pumping high pressure fluid to the said PHV.

5. The accumulated wind and wave power plant, as claimed in claim 1, wherein the said PHV engine is fed by high pressure fluids, the said engine comprising a pressure chamber above a piston with rings sliding in reciprocal fashion in a cylinder, the said piston has a connecting rod which is meshed rack and pinion fashion to a free wheeling clutch mounted on an output shaft, said piston has a calibrated return spring underneath and connected to the rod controlling the valve train.

6. The accumulated wind and wave power plant of claim 5, wherein said PHV operates by allowing high pressure fluid into pressure chamber which compresses the piston together with the return spring to bottom whereby actuating the exhaust valve to empty the cylinder, at the same time, actuating a mechanism to release the piston rod which is momentarily restrained at bottom position, thus, the return spring discharges its energy through the connecting rod which drives the output shaft.

7. The accumulated wind and wave power plant as claimed in claim 5, wherein said PHV engine is a fast steam engine, a high efficiency compressed air motor, a high efficiency hydraulic motor, said PHV engine makes possible the economical and safe transmission of electricity for long distances, where the turbines of remote hydro thermal plants may directly drive compressors and/or high pressure water pumps through pipelines to feed PHV engines coupled to generators where needed.

8. The accumulated marine wind and wave power plant as claimed in claim 1, wherein said ocean depth and land depth storage systems make use of deep ocean as an elevated structure in relation to a floating platform from which weights are suspended sequentially to function as an accumulator of energy, said storage system similarly being worked on land such that a similar structure consist of deep trench on land over which weights are operated.

9. Accumulator marine wind and wave plant of claim 7, wherein the suspended weights function as mechanical battery to store substantial amount of energy with negligible

loses.

10. The accumulated marine wind and wave power plant of the preceeding claims wherein power generated from the said power plant is subsequently utilized in the generation of electricity and power dependent devices.

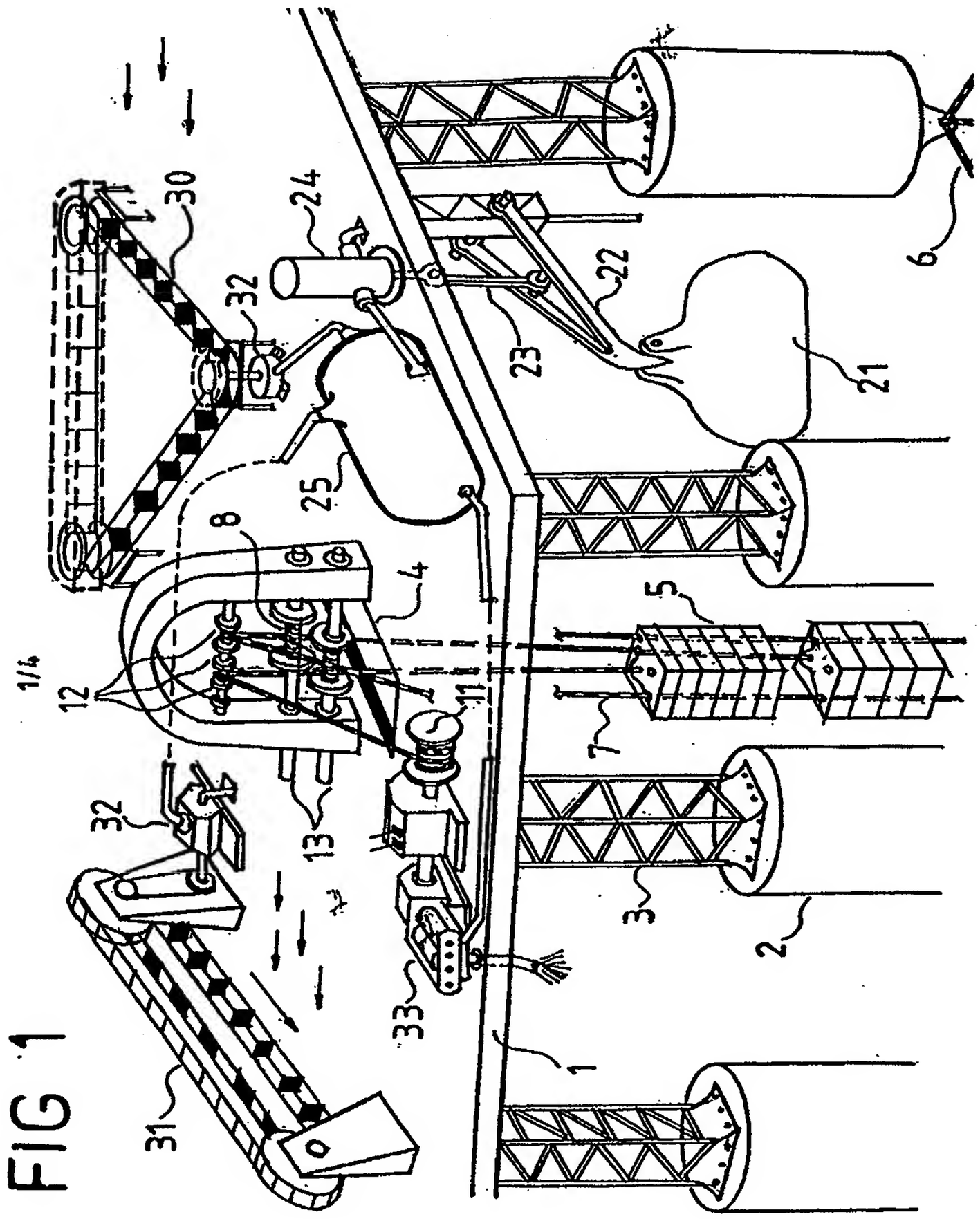


FIG 1

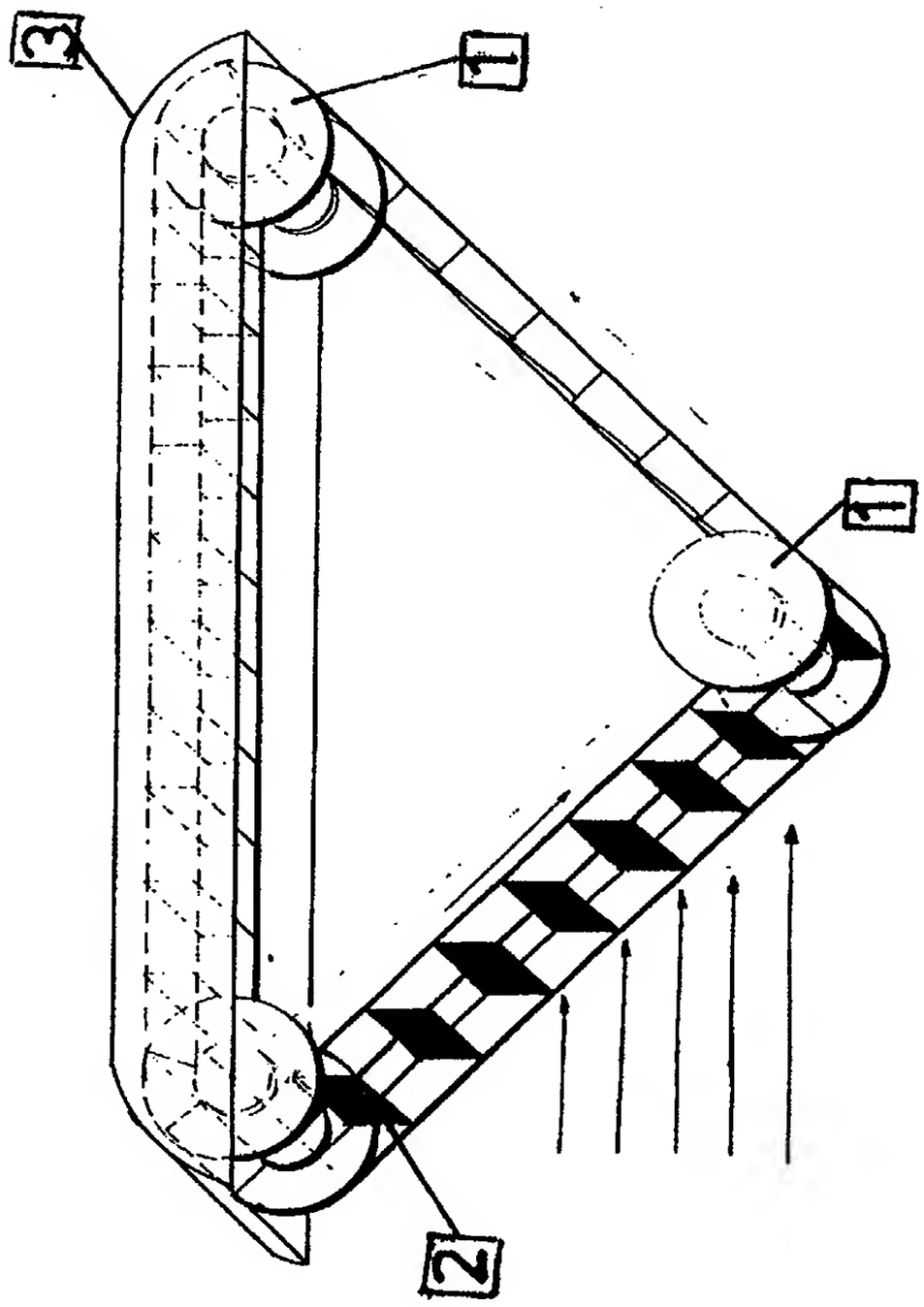
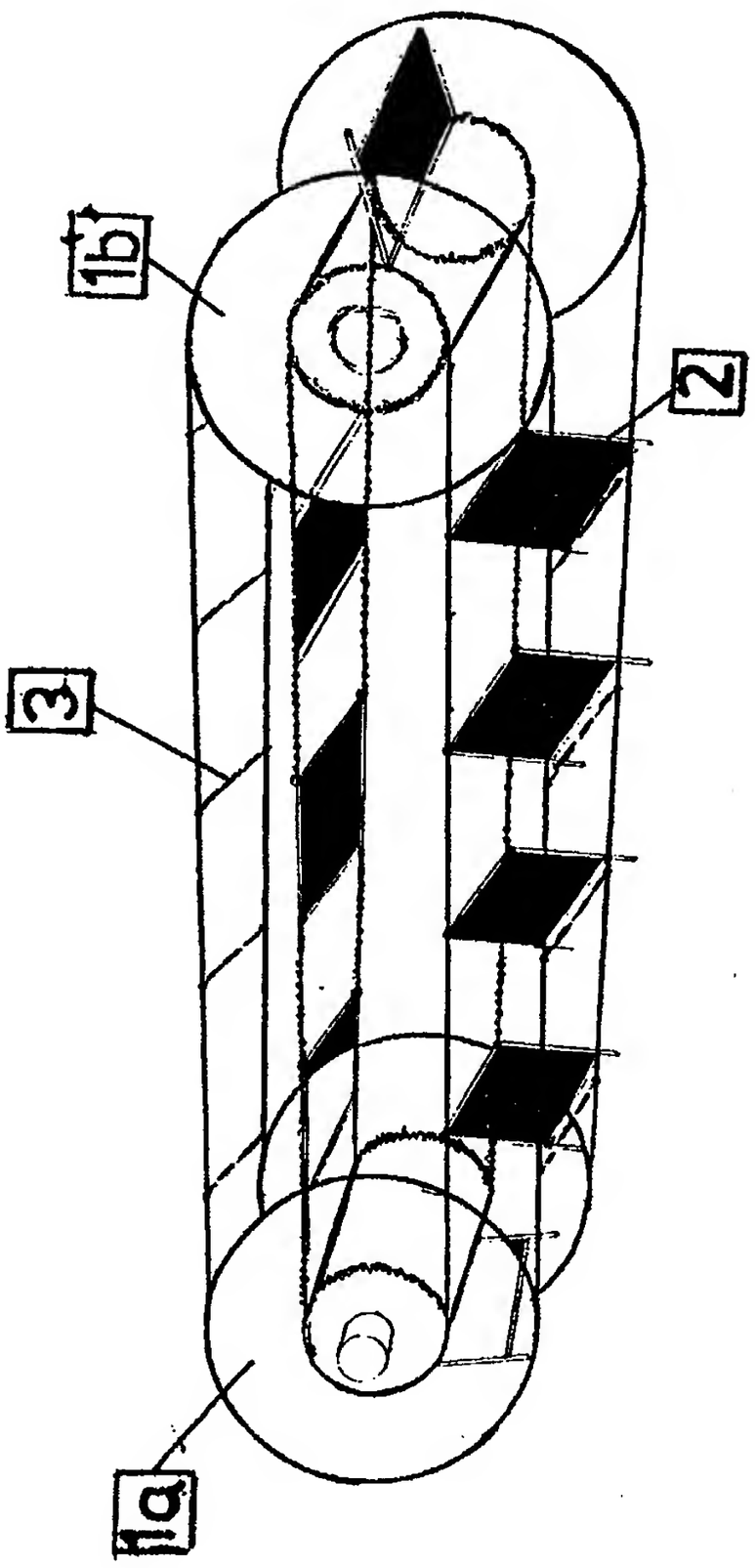


Fig 2

Fig. 3



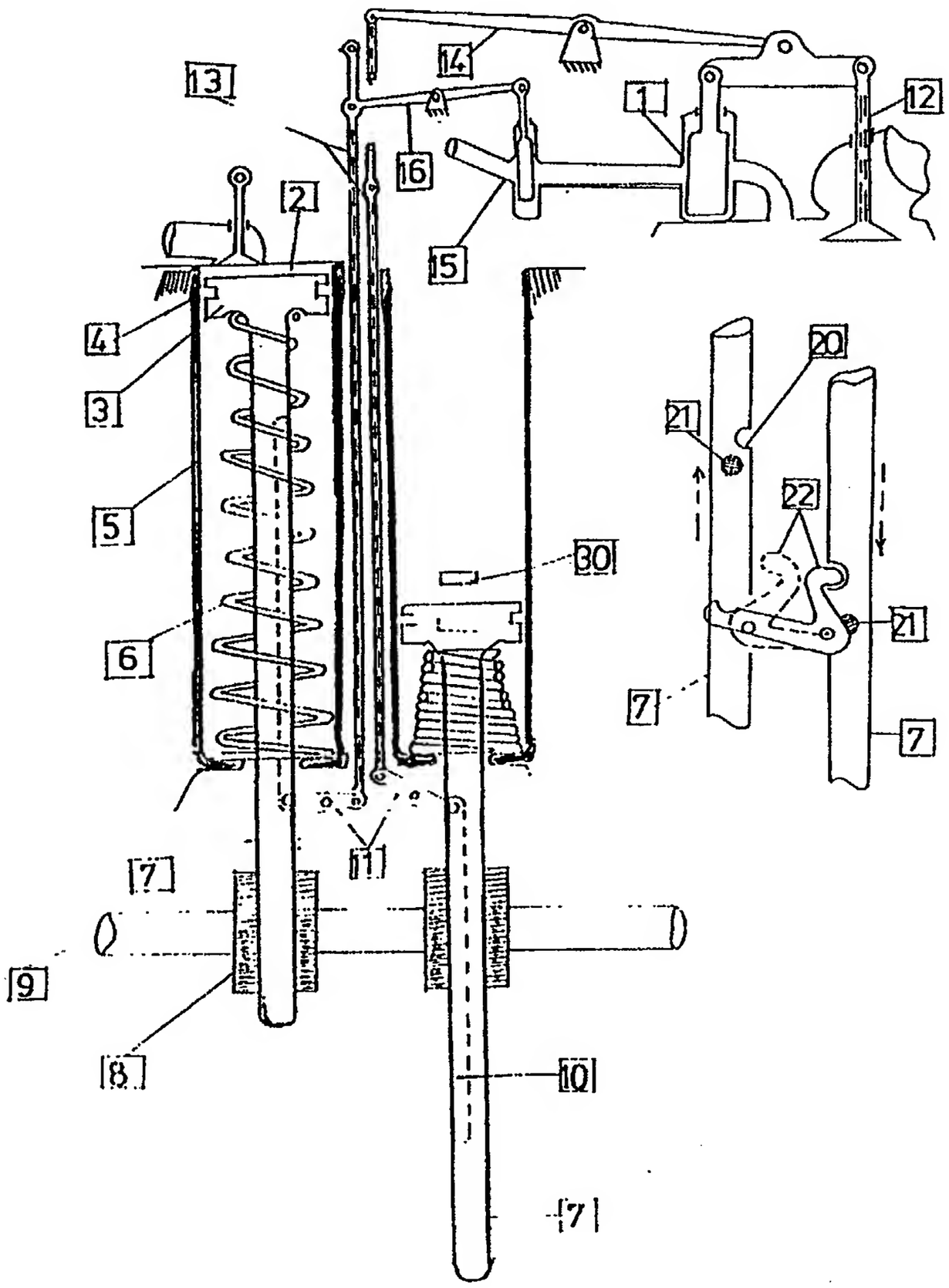


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GH 99/00001

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F03D 9/00, F03B 13/14
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: F03D, F03B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 8203662 A1 (JÖST, B.), 28 October 1982 (28.10.82), figure 1, abstract ---	1
A	US 4316704 A (P.C. HEIDT), 23 February 1982 (23.02.82), figures 1-10, abstract ---	1
A	US 5549445 A (E.J. SCHREMP), 27 August 1996 (27.08.96), figure 4, abstract ---	1
A	US 4266403 A (F. HIRBOD), 12 May 1981 (12.05.81), figure 1, abstract --- --------	1

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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